General Walker

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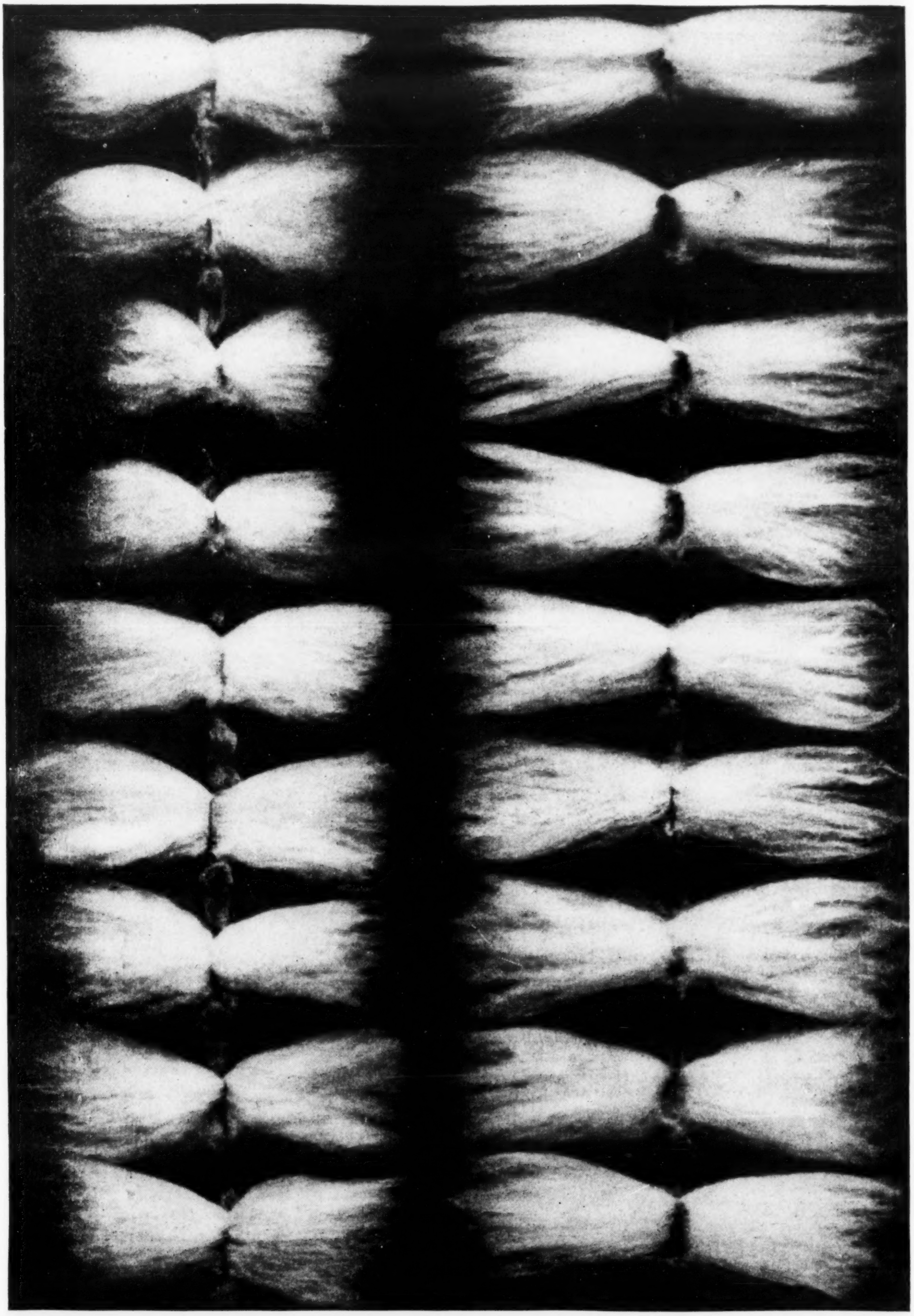


COTTON MADE UNIFORM BY BREEDING

Frontispiece

The most important effect of selective breeding is to make the fiber more uniform. Compare the selected Meade cotton in the right-hand column with the unselected stock in the left-hand column, each combing and seed representing individual plants as they stood in the rows. A few plants of the mixed stock had lint as long as the selected variety, but the short staple has to be combed out as "waste" in the spinning process. (Reduced.)

COTTON CLASSED IN THE FIELD

Production Standardized by Maintaining Uniform Varieties

O. F. Cook
Bureau of Plant Industry

APPLICATIONS of heredity may not be limited to the breeding of superior varieties of cotton and the roguing of seed-stocks. The object of breeding is to get larger yields and superior quality of fiber, to be sold at higher prices in the market, but the improvement of production also opens the way to a better system of standardizing the cotton crop for commercial and industrial purposes. Many of the difficulties and expenses in the marketing of cotton are connected with the "classing" or classification of the fiber in the bales.*

The object of classing is to determine the length and quality of the fiber, and to sort the bales into "even running lots" as required by the manufacturers. It is important that the cotton be as uniform as possible, since the spinning and weaving of uneven fiber are more difficult and costly. More labor is required because the threads break with greater frequency, and the fabrics are inferior to those that can be made with uniform fiber.

Classing as an Art

The classing operation is recognized as a special art, requiring a delicate discrimination of slight differences that the ordinary observer would fail entirely to appreciate. Years of experience are required, in addition to naturally sharp senses of touch and eyesight, to develop a really competent and skilful classer. Recognized classing experts are difficult to secure and are highly paid for their services. Even with the best talent employed, the results may be disappointing. The work of different classers on the same bales may fail to check, and the judgment of the same classer may fluctuate from day to day, to an extent that may cause losses or gains of thousands of dollars. Thus classing is one of the commercial hazards, and complicates the responsibilities of marketing associations.

A recent economic writer has suggested that the variations in classing might be reduced if more attention were given to the personal habits and home life of the professional classers, in order to secure greater regularity in their work of discrimination:

> The structure of the cotton industry, spreading over all of the Southland, depends to a great extent on the home life and the temperate habits of men who have charge of the classification of the cotton for shipment.
>
> For this reason it is highly desirable that shipping classers be men of temperate habits and with pleasant home life, otherwise they will have too many bad days; days when they are not themselves.
>
> Cotton classing is an art and therefore it must be safeguarded with proper environment or the result will not be satisfactory. Upon the quality and deliveries depends the continuation of orders from the spinners.

The economic writer does not treat the agricultural side of the problem or state the chief cause of the difficulties in classing; that much of the cotton in the bales is of mixed, irregular quality. Samples from the same bale may be different, or parts of the same commercial sample may vary, so that the bale may be placed in different commercial classes. The most careful discrimination of the quality of the samples is ineffective and misleading when the bales are uneven. Mixed or "plated" bales are troublesome at the mills, and

*Brief statements on field classing have appeared in the annual reports of the Chief of the Bureau of Plant Industry for 1920, 1922, and 1923. See also U. S. Department of Agriculture Bulletin No. 60, "The Relation of Cotton Buying to Cotton Growing," February, 1914.

cause rejections, reclamations and appeals that are costly to dealers or to market associations. It is plain from the production side that no system of classification of bales can be completely effective and satisfactory until the cotton in the bales is more uniform.

To Standardize Production

Much of the cotton is of irregular quality because a careless and wasteful system of production is followed. The nature of the system and its effects upon the quality of the fiber were not recognized in the past, until the problems of breeding were studied. The chief causes of deterioration of varieties and of the consequent production of inferior and irregular fiber are the mixing of seed at the public gins and the crossing of the plants in the fields. Finally it was recognized that the only practical way to keep cotton varieties pure, and to have pure seed in sufficient quantities for the production of uniform cotton in commercial lots, is to grow only one variety in each community.

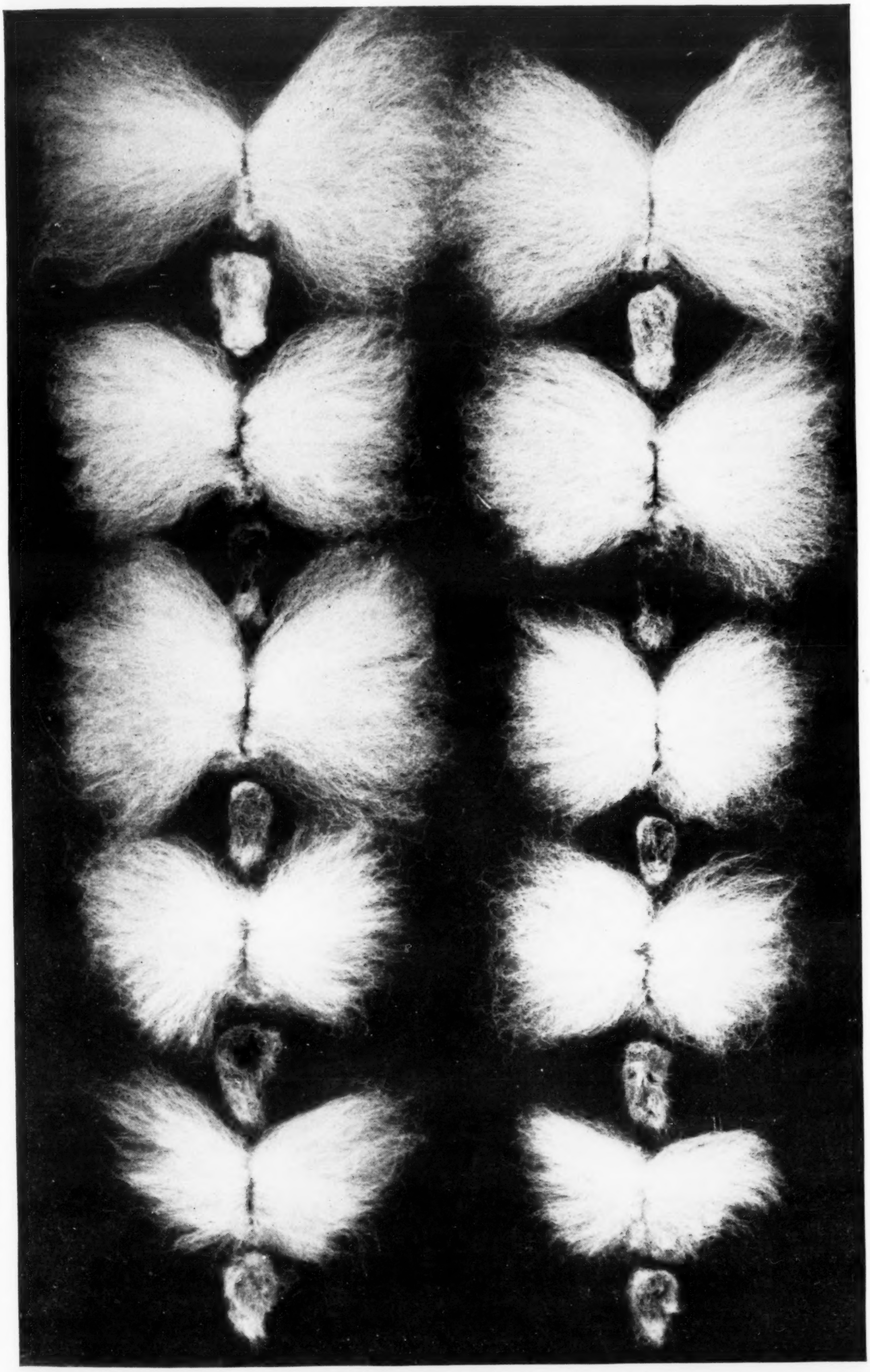
The custom of planting different kinds of cotton in neighboring fields and mixing them together at the public gins is *essentially* and needlessly wasteful. Selection and roguing are needed to maintain a variety at a high stage of uniformity and productiveness, but the breeding precautions are in vain if the seed stocks are not kept apart. No advantage is gained from the miscellaneous planting of different varieties and mongrelized "gin-run" seed stocks. Only losses and difficulties result, of which the classing complications are a part. The commercial system can be improved most effectively by improving the production system, to make the crop more uniform, as well as to secure larger yields and better quality of fiber. The crop is handled to the best advantage in communities that raise only one variety.

With other important crops, production is standardized by varieties more readily than with cotton, the orchard fruits by grafting or budding, potatoes and sugar-cane by vegetative propagation, wheat by being self-fertilized and corn by selection of good ears. Fields of tobacco can be grown from the seed of a single plant, which may have a million seeds, while a cotton plant has at the most only 500 or 1,000. At the same time the need of standardizing is greater with cotton than with most of the other crops. Facility and cheapness of manufacture depend on uniformity of fiber, to meet the fine adjustments of the spinning and weaving machinery.

Even if no further improvement of varieties were possible, the standardization of the cotton in the field, by careful breeding and separate planting of the varieties, would be an enormous advantage to the cotton industry. All of the cotton would be more valuable by being more uniform.

Where pure seed of one variety is planted and the field conditions are not too unfavorable, the fiber is uniform, and the bales do not need to be classed separately to make "even-running lots." The "character" and spinning qualities of cotton are largely determined by the variety. Certification of the variety and of production in a pure seed community would afford the best evidence to manufacturers regarding the quality of cotton.

The cotton of a one-variety community is standardized already in the field, since the quality of the fiber is more uniform than the mixed product of an unorganized community can be made by classing the bales. All that can be expected from the classing of a mixed and miscellaneous crop is to arrange the series of bales so that the differences are less abrupt. The soil or other field conditions may be so variable as to render the cotton less uniform in some districts than in others, but experience has shown that the effects of irregular conditions are much easier to recognize from the plants in the fields than from the cotton in the bales. The best protection for local buyers is to know the seed stocks and the field conditions.



VARIATIONS OF COLUMBIA COTTON

Figure 1

Variations in lint and seed characters are found even in the best varieties, so that continued selections and roguing are necessary to maintain the uniformity of the fiber. Some variations are called "buterfly," with very short fibers at the base of the seed and longer above. The upper combings of this photograph show normal fiber of Columbia Cotton, with short and butterfly variations below. (Natural size.)

The present commercial system appears very defective in relation to improvement of production, since it does not carry back to the farmer any of the advantages of producing better and more uniform fiber. A progressive farmer who plants good seed and raises better fiber often finds that he must sell at the same price as his neighbors who grew the shortest or most irregular fiber. Most of the cotton is bought from the farmer at "flat" prices, with no recognition of quality. The subsequent commercial classing of the cotton has no beneficial relation to the farmer, to encourage the planting of better varieties. The price advantages of the improved cotton are absorbed entirely by the buyers. The farmers are discouraged when they see that the raising of better cotton has only exposed them to unfair treatment in the market.

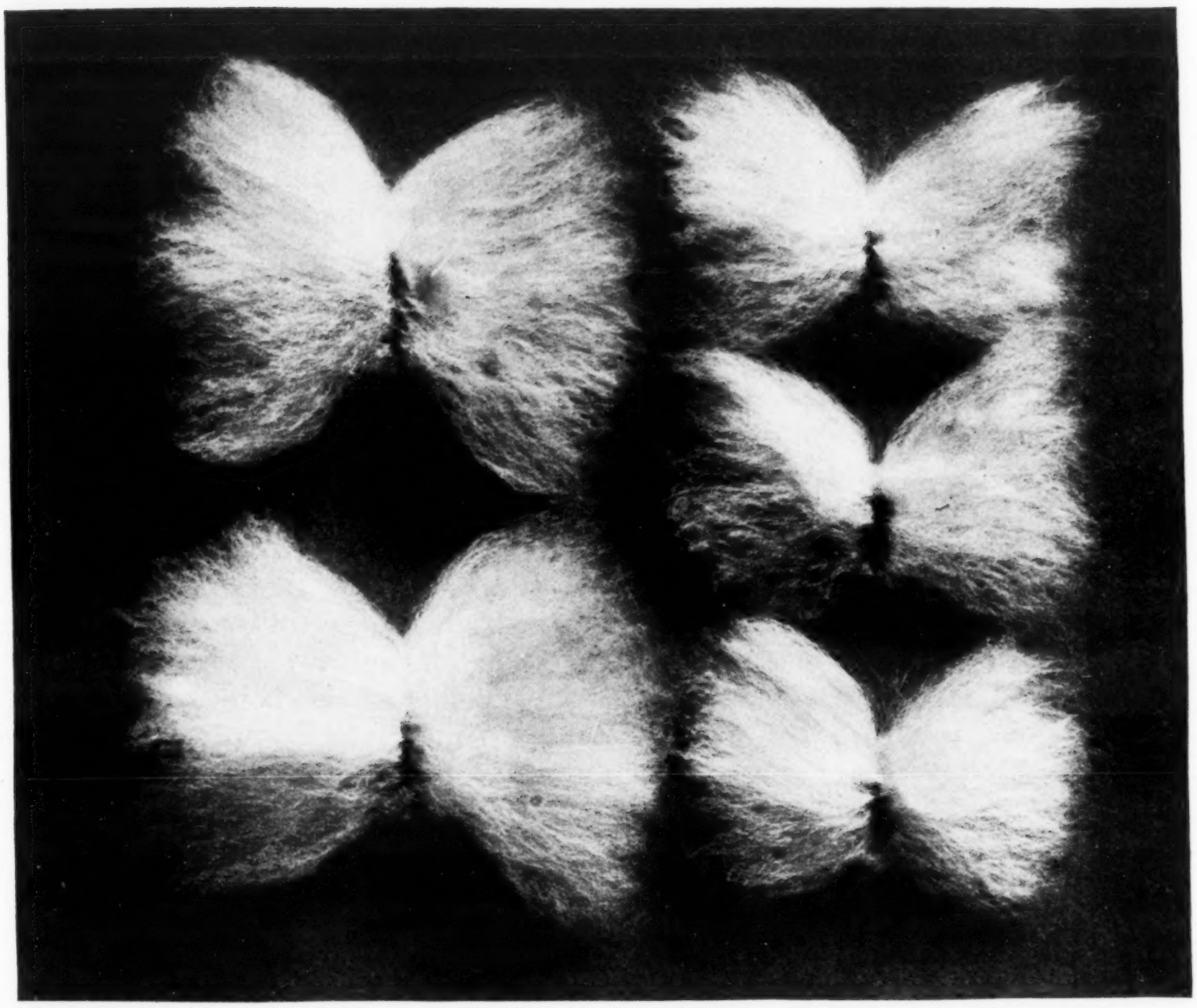
The only assurance of establishing better market relations and getting the price advantages, is through the production of superior fiber in commercial quantities, as in one-variety communities. It is not reasonable to expect that the commercial system can be expanded to the extent of competent classing of the individual bales of cotton in the primary markets, or while the cotton is still in the hands of the farmers. Some communities have hired classers, but still find it difficult to get full values for small lots of good fiber. It is only through the production of large quantities of good fiber that the community places itself in a position to secure the advantages of improvements of production.

Classing Simplified

In the communities where only one variety of cotton is grown and the entire crop is raised from seed of the same quality, it is found that the fiber is uniform and that classing of samples from individual bales is unnecessary. Not only the length of the staple, but the strength and other spinning qualities of the fiber can be standardized more effectively on a basis of pure-bred varieties and carefully guarded seed-stocks than in any other way. Experience in one-variety communities in Arizona and California shows that many difficulties and wastes incidental to classing, reclassing, rejections and arbitrations of bales, with the repeated cutting of the bales to draw more samples, are avoidable through improvement of production. It greatly facilitates the co-operative marketing of cotton to have a uniform, field-standardized product that can be offered in commercial quantities to responsible buying firms, or direct to manufacturers.

Inspection of the cotton in the field shows at once the nature of the fiber that goes into the bales, as though all the bales of a commercial lot were opened and the fiber spread out for close observation. Thus field classing is much more thorough and adequate than the classing of bales, which necessarily is based upon small samples that may not be representative of the bales from which they are drawn. If the plants in the field are a mixture of different varieties, or the varieties have crossed and mongrelized, or selection has been neglected too long, the fiber will not be uniform in the bales.

The "grade" of cotton is determined by the condition of the fiber, whether clean and white or dirty and stained. Wet weather, careless picking, and incompetent ginning may lower the grades, and are matters that should receive attention before the cotton goes into the bale. If adverse conditions are encountered the effects upon the fiber can be known by field inspection more promptly and definitely than after the cotton is in the bales. The ginner knows the condition of the seed cotton when it comes from the field and whether it is dry enough to be cleaned and ginned properly without "gin-cutting." Thus it is possible and desirable for the grading as well



A DEGENERATE COTTON "ROGUE"

Figure 2

Even in the best stocks occasional off-types plants, or "rogues," are found, some of them sterile and others fertile, but very different from the parent variety, and usually with short inferior fiber. This example of a rogue is from the Lone Star cotton, a Texas big-boll variety, three combed seeds of an off-type plant at the left and two seeds of an adjacent normal plant at the right. (Natural size.)

as the classing to be done in advance, before the cotton goes into the bales. Better ginning work can be done with the uniform cotton of one-variety communities, and the relations of ginners to the organized communities become more responsible.

A general improvement of the cotton crop is possible through the planting of better varieties, but the systems of production and marketing also need to be changed in order to get the full advantage. With good varieties available, there is no reason for continuing to produce in the United States any of the very short and irregular fiber that has to be sold in competition with the cotton of India or China. A high lint percentage or turnout at the gin does not prove that a short-lint variety is more productive or more profitable than a variety with good fiber. It is a wide-spread error to suppose that the gin turnout is the most important factor. Ginners meet demands for high turnouts by running more trash and waste into the bales, so that the farmer loses on the grade and staple. There is no occasion to plant in any of our cotton-growing regions, varieties with less than inch staple. That millions of acres are planted with short, inferior varieties or with mixed, gin-run seed, appears as an enormous

waste of the resources of production, when the possibilities of improvement are recognized.

The most active appreciation of such possibilities is in the irrigated valleys of California and other Southwestern States where farmers have had experience in working out co-operative improvements, especially on the side of marketing their products. The farmers of the irrigated valleys readily understand that a profitable, stabilized cotton industry will require a better system of marketing, and that the first essential in the improvement of marketing is to have a standardized high-quality product. In some of the valleys experience has shown that the production of short uneven staples in direct competition with the eastern cotton belt does not afford a satisfactory return for the higher costs of labor, land, and irrigation charges, but with cotton that is sold at a premium of from 3 to 5 cents a pound, a different type of cotton industry becomes possible. The issues are made more direct because there are many people who are opposed to cotton-growing as likely to have a bad effect upon the agricultural development of California.

An editorial in *The Pacific Dairy Review* for November 19, 1925, says:

"Quite recently an event took place in the city of Oakland that furnished material for a lot of space in the newspapers published around the Bay. California cotton was the motif and Oakland Chamber of Commerce and other local commercial interests furnished and disseminated the enthusiasm. It was all over the fact that it signaled the loading of the first ship-load of cotton to sail from a port in Central California to Europe. . . . We can understand their enthusiasm in this respect but when they talk about making California a great cotton producing State it makes us sigh. Let us hope that their dreams fail to materialize for the good of our State. Of all lines of agricultural production, cotton stands at the bottom when it comes to a prosperous agriculture and the development of an intelligent and contented farm population. No line requires less brains. It has been said that the essentials in cotton growing are a 'nigger and a mule.' Even 'horse-sense' seems to be unnecessary. Cotton growing means agricultural degradation, intellectually, sociologically and, generally, financially. Let us hope California will be saved from its influence. . . ."

While the cotton industry has its deplorable features, the abuses that arise from the methods that have been followed in the past are not inherent in the plant or the product. No other crop is more in need of intelligent handling, or better adapted to serve as the basis of a permanent and prosperous agriculture, for intelligent high-standard people. That careless and incompetent people grow poor cotton and sell it to little advantage is only what might be expected, and only emphasizes the need of constructive intelligence in working out a better system of producing and marketing the crop. It is being recognized in California that the practice of loaning money on crop security is responsible for much of the "agricultural degradation" ascribed to cotton. Bankers who are interested in a stabilized development of agriculture in their communities see that the subsidizing of incompetent farmers is bad policy, and that the crop loan system of the eastern cotton belt needs to be restricted or avoided entirely in California. A community with too many backward farmers undoubtedly is handicapped in the effort to standardize production and improve the market contacts. All of the factors of the problem must be taken into account in working out practical solutions. The social and economic adjustments are more readily made in the new communities. Not only the supplies of pure seed, but other progressive features that are being developed in the irrigated valleys, may be used elsewhere.

Of course, it is out of the question to expect a rapid change of the commercial system, since only a few districts have regular supplies of pure seed for raising uniform crops. Practical breeding work is restricted to communities that specialize on one variety, and stocks of pure seed are entirely inadequate for general use. This is the reason why only a few

districts can offer regular supplies of uniform fiber that are needed by the automobile industry, or to meet special demands for strength and durability. A gradual extension of pure-seed communities is to be expected, but many years may be required for a general reform of production to be consummated.

Yet it may be in the interest of progress to know that the system of classing could be improved and that the activities and powers of discrimination now applied to the classing of the individual bales of cotton could be used much more effectively in selecting and guarding the supplies of pure seed, for producing a uniform standardized crop. Talents of careful discrimination which could be applied to the general improvement of the crop through whole communities or districts, are being wasted on the sorting of individual bales. The cost of maintaining uniform seed-stocks certainly would not be greater than for classing the bales of the present miscellaneous product, and the cotton would be much more valuable. Eventually a standardized production and certification of pure varieties may replace the classing of samples from bales, and the one-variety system of production may become general.

Scientific Consolation

I was conversing with some gentlemen on the subject of evolution in its purely scientific aspects. A lady sat listening, and when the others had gone, she remarked to me, "It is a most horrible doctrine," I was startled by her look—there was in it pallor, and an expression of mental suffering. "What is horrible?" I asked. "Why, that doctrine you have been all talking about—the survival of the strongest. It may be that it is the law of nature that the weak should be trampled out by the strong, but it is dreadful." Her eyes were filled with tears. I answered, "I believe in no such doctrine as the survival of the strongest,—nor do those scientific men believe in it. They believe in the survival of the fittest; but mere strength is not fitness. The survival of the strongest were indeed a horrible doctrine; but all nature is against it. Huge, monstrous things that were only strong—moving mountains of force, mammoth and megalosaurus—have perished because they were merely strong, and so not fit to survive; the forms of cruelty and brute force have had to give way before things much weaker; the lions have decreased before the lambs; and man, weakest of all animals at birth, has been awarded the sceptre of the world because he was fittest through his power to love, to consider, to deny himself for others."

I had the happiness of witnessing the relief of that young heart when she discovered her mistake,—that the horrible doctrine of the reign of brute force has been especially crushed by that of evolution, which proves the steady triumph of the gentle forces of sympathy and justice. How much misunderstanding of this kind envelopes all great truths when they first ascend the horizon, so that human hearts tremble like the watching shepherds when they saw their star. "The glory of the Lord shone round about them, and they were sore afraid." 'Tis an old poem, but ever repeated. . . . .

There is nothing whatever in this theory which veils to man a single expression of wisdom, or love shining through the mystery around him.

Nay, on the contrary, I will maintain that this theory has added fresh tints of love, brighter beams of reason to the universe by opening our eyes to new aspects of it. It has illuminated for the first time the dreary track of pain and wrong. The pre-Darwinite might say to the suffering, "I hope and

trust your pain is for some good end;" but the post-Darwinite can say with confidence, "I know and see that pain is a beneficent agent. Pain has been the spur under which the whole world has progressed. To escape danger, to survive pain, every form has gained its fleetness, its skill, its power; the hardships of nature gave man his arts to conquer it; the cruel elements built his home; and in the black ink of sin were written the laws of morality and civilization.

And if this theory has for the first time taught man the sublime uses of evil, none the less has it harmonized nature with the laws of his reason. For in their best statement the old pre-Darwinite views of nature made it discordant with the intellectual history of man. History shows us a continuous moral, mental, and religious development of humanity. The theories, the philosophies, the creeds of mankind have not been distinct and isolated creations; they have been an unbroken series of religions, schools, ideas, each growing out of one preceeding, giving birth to another, so that step by step we trace philosophy back from Huxley to Moses, or religion from Christendom to Assyria and India. This unbroken evolution of thought in human history we find repeated in the unfolding intellect of every individual being. We do not think one thing, and then a totally different thing, and feel that there is no link binding our days and our purposes together into a life that represents an individuality. Yet we had long been looking out into nature and seeing it as a set of distinct creations; one form made, then another. We may well reverence the great men who have found in the universe one theme with endless variations.

Conway, M. D., 1877, *Idols and Ideals.*

The Conservation of the Family

LE LIEN FAMILIAL: Causes Sociales de Son Relachement, by G. L. DUPRAT, professor of sociology at the University of Geneva. Pp. 268, price f. 12. Paris, Librairie Felix Alcan, 1924.

This is one of the most valuable contributions to the broader field of eugenics that has appeared in recent years Written from the point of view of social psychology, it is scholarly, balanced, and penetrating. The author analyzes in detail the breakdown of the family, and suggests detailed ways in which its integrity can be reconstituted. The book, which was crowned by the Academy of Political and Moral Sciences, deserves wide reading.

P. P.

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COLLEGE MEN AND THE BIRTH RATE

A Note on the Present Day Undergraduate Mores Relating to Family Size

STUART A. RICE and MALCOLM M. WILLEY
Dartmouth College

THERE have been in recent years numerous statistical studies showing the tendency of the birth rate among the intellectual classes, and particularly among college graduates, and among families from which college students are recruited.* All of these have shown a downward movement and make it clear that the college groups, speaking broadly, are not reproducing themselves. Significant as these studies are statistically, most of them have not indicated what the individuals in these same college groups were thinking in reference to the size of American families. To a large extent, the approved size of the family in any age is closely bound up with what the sociologists have called the *mores* of the group—types of behavior which have received the stamp of social approval. These change from generation to generation. The individual of any period absorbs the *mores* with which he is surrounded from the time of his birth, and his opinions, whether the result of rational thought or not, tend to reflect the *mores* of his time. Present and future tendencies with respect to the birth rate, must therefore be considered in the light of imperceptible changes in the *mores*. It is apparent that the birth rate is more and more becoming a function of conscious reflection, but the latter is in the nature of a conscious adaptation to *mores* that have been accepted uncritically.

In view of these considerations the attitudes of a selected number of college undergraduates toward the size of the family will be of some significance. The occasion for an inquiry among their students along these lines recently came to the writers in connection with a picture published in the rotogravure section of one of the Sunday papers. This showed a prosperous middle-class family consisting of two parents and seventeen children. The students whose attitudes were sought, 130 in all, were members of an introductory course in sociology at Dartmouth College. In groups averaging 20 in number they were shown the picture and asked to set down first their immediate unthought reaction to the family situation represented. Immediately following they were asked to describe in more detail their emotional response upon seeing the picture. Finally they were asked to reply to this question: In your day-dreams of marriage, do you visualize children; if so, how many?† The replies were anonymous.

Several striking uniformities of attitude can be seen in these replies. In the first place, a majority of the answers could be classified into two well-defined and sharply opposing points of view. In numbers they are about equally balanced. On the one hand strong approval and commendation were expressed. On the other was disapproval, often accompanied by extreme disgust. Of the first type the following expressions are typical:

*See, for an excellent example of the latter the excellent study by Dr. S. J. Holmes in the *Journal of Heredity*, October, 1924.

†In two groups this question was not asked.

> It appeals to me very much. . . . I think it is ideal to have a large family. . . . I wholeheartedly commend the parents

> It always gives me a peculiar pleasure to view a large family such as this.

> It must be wonderful to belong to a family like that.

In contrast:

> I may be very foolish to react this way, but large families have always aroused disgust in my mind.

> It may be that I have an inherent bias against large families, but this picture does certainly irritate me.

> My first reaction is one of repugnance. A family of such size seems immodest. . . . My reaction is one of disgust.

Another well-defined attitude centers around the mother. This can best be expressed as a feeling of consideration for the physical pains undergone in childbirth, and the sacrifices and hardships attendant upon the rearing of a family. It is evident that most of these young men feel thoroughly reluctant to subject any woman to the hardships entailed in childbirth. They are weighing carefully these hardships against the desire for and the responsibilities of parenthood. This attitude is well illustrated in the following:

> I can't imagine the immense amount of pain a woman must have suffered in bearing those children.

> The burden of the mother in bearing each and every one of 17 children irritates me.

> A man can't love his wife to cause her to give birth to so many children. The pain and suffering involved is so terrible that many loving couples have no children. And this man has 17 or 18!

The answers relating to their own day-dreams of marriage and resulting children are illuminating:

Seven only of 90 men to whom the question was put stated that they had no such day-dreams. Of the remaining 83, 82 admitted a visualization of children. One man only expressed a desire for a childless marriage. Three were indefinite concerning the desired size of their dream family but the remainder were specific, the distribution being as follows:

No. of children desired	No. of men
0	1
1	2
2	38
2 or 3	9
3	15
3 or 4	3
4	6
4 or 5	1
5	3
5 or 6	1
10	1
	80

It is readily observed that 62 among 80 men expressing a specific preference desired a family of either two or three children, which according to accepted authorities, is not enough to reproduce the group represented.* It is interesting to note that the number of children preferred bore no relationship to the attitude expressed toward large families. Even those most laudatory in their praise and admiration of the family whose picture was shown, in so far as their own personal desires for two or three children are concerned, are in complete accord with those who disapproved of this same large family. Alike in their own wishes for a small family, the two groups differ only in toleration of those who have large ones.

It is clear to the extent that these students are representative of the coming generation of college-bred parents, that families of a size less than sufficient for the perpetuation of their class meet the approval of the group *mores*.

*L. I. Dublin, *J. Am. Statis. Assn.*, March, 1925. Dr. Dublin calculates that on the average, 3.1 child per married couple having children are needed to preserve a constant population in the group. He also states that one marriage in six is childless. *Cf.* Holmes, *op. cit.* "It is, therefore, a matter of doubt if with our present death rate, an average of 3.5 children would suffice to reproduce the general class of fairly well educated people who supply our college students."

JUDGING OF DAIRY CATTLE AND SOME OF ITS PROBLEMS*

JOHN W. GOWAN
University of Maine

THE problems relating to conformation in dairy cattle seem to fall into two general classes: (1) the influence of inheritance on conformation and productivity of the animals, and (2) the relation of conformation to the productivity of the cow. These problems are of long standing. They have furnished the basis of discussion and argument since cattle first left the show ring. These discussions were crystallized into written form a century or so ago largely through the efforts of Le Couteur. While Le Couteur was undoubtedly a keen observer, his score card is probably to be interpreted as a codification of the points or rules of judging rather than as a product based on extensive or careful study to determine the relation of these parts to the productivity of the animal.

This early score card has come down to us with relatively little change in its essential ideas. The weighting of different parts has been changed to some extent, or attention has been directed to other parts than those first indicated, but on the whole these changes have been of minor importance compared with the fact that the central ideas have remained intact. Furthermore, these changes have contributed but little to establishing whether or not the germ of the idea were true, namely, is conformation inherited or is conformation related to productivity? These problems are particularly to the fore in dairy cattle as compared with beef cattle, for with dairy cattle the characteristics of milk yield or butter-fat percentage are relatively hidden to the observer as compared with the characteristics depending so largely on the quantity and quality of the fleshing on the bones of the cow.

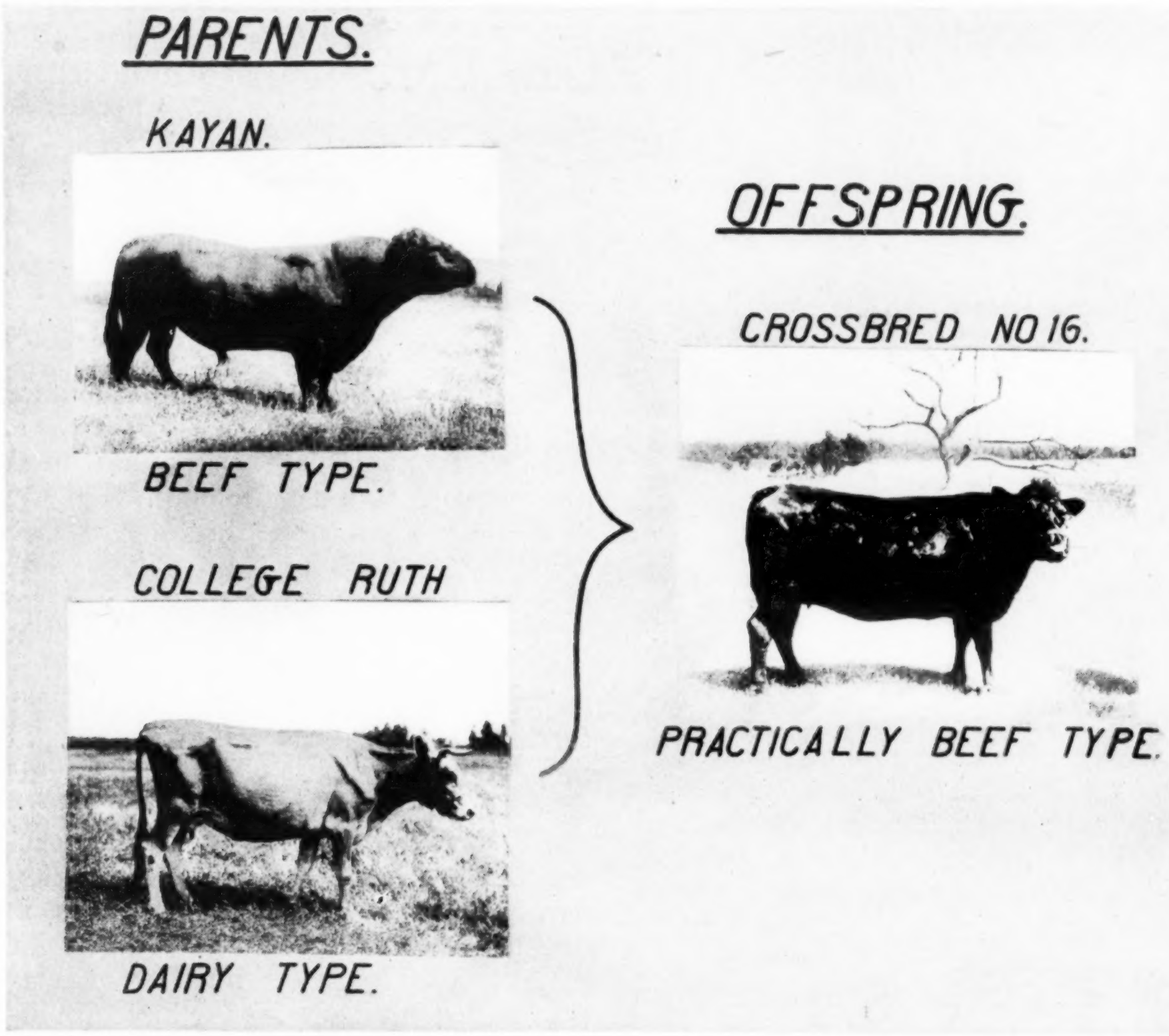
Is Conformation Inherited?

The first problem, the inheritance of conformation, is yet an open one. No satisfactory information has been presented to support the claim that the finer points of the dairy cow are transmitted to the offspring. The breeder who has studied the problem in the wider crosses will without doubt conclude that gross conformation is an inherited characteristic of dairy cattle. This is particularly true of those investigators who have made as wide crosses as that shown in Figure 3. Here the beef type, Aberdeen-Angus, has been crossed on the extreme dairy type, Jersey, resulting in the F_1 offspring illustrated. The extreme beef type of the first generation shows that she must have inherited this beef type from her sire. This crossbred is on the whole quite typical of such crosses as found in our breeding herd. One cannot but believe in regarding such animals that inheritance of conformation takes place. The beef breeder has utilized these facts in his breeding herd much more completely than the dairy breeder as seen by the fact that over 50 per cent of beef bulls are registered while only 25 per cent of dairy bulls are of purebred registration. The problem of the relation of conformation to productivity is in better condition, although here much more work remains to be done.

Conformation and Productivity

Graves presented some of the first information designed experimentally

*Delivered at the meeting of the Geneticists Interested in Agriculture, Dec., 1924.



INHERITANCE OF CONFORMATION

Figure 3

The rounded, blocky beef type of the sire appears to be transmitted to the offspring.

to test the value of certain points of conformation with regard to productivity in dairy cattle. His experiment consisted of a ligation of the milk veins leading anteriorly from the udder. These experiments were carried on with Ayrshire and Holstein-Friesian cows. No appreciable diminution in milk flow occurred after the operation was performed and the cow had recovered from the shock. It is pointed out that the blood supply from the udder also flows through the posterior veins which remain unobstructed. In view of the fact that these veins may carry all of the blood supply of the mammary gland it seems probable that the experiment as designed would furnish but inconclusive evidence on this question, unless the results were positive in the extreme, for while under normal conditions the anterior milk veins might very likely be large if the blood supply of the udder was large, under the stress resulting from such an operation as that performed, it is pointed out as highly probable that the posterior veins would be able to take care of the entire blood supply even though the anterior veins might normally indicate by their large size that the blood supply of the udder was large.

The experiments of Aldrich and Dana on actual measurements of nearly 600 cows for the items, milk

7-Day and 365-Day (Same Lactation)

MILK

BUTTER FAT PERCENT

BUTTER FAT

7-Day and 365-Day (Different Lactation)

MILK

BUTTER FAT PERCENT

BUTTER FAT

365-Day and 365-Day

MILK

BUTTER FAT PERCENT

BUTTER FAT

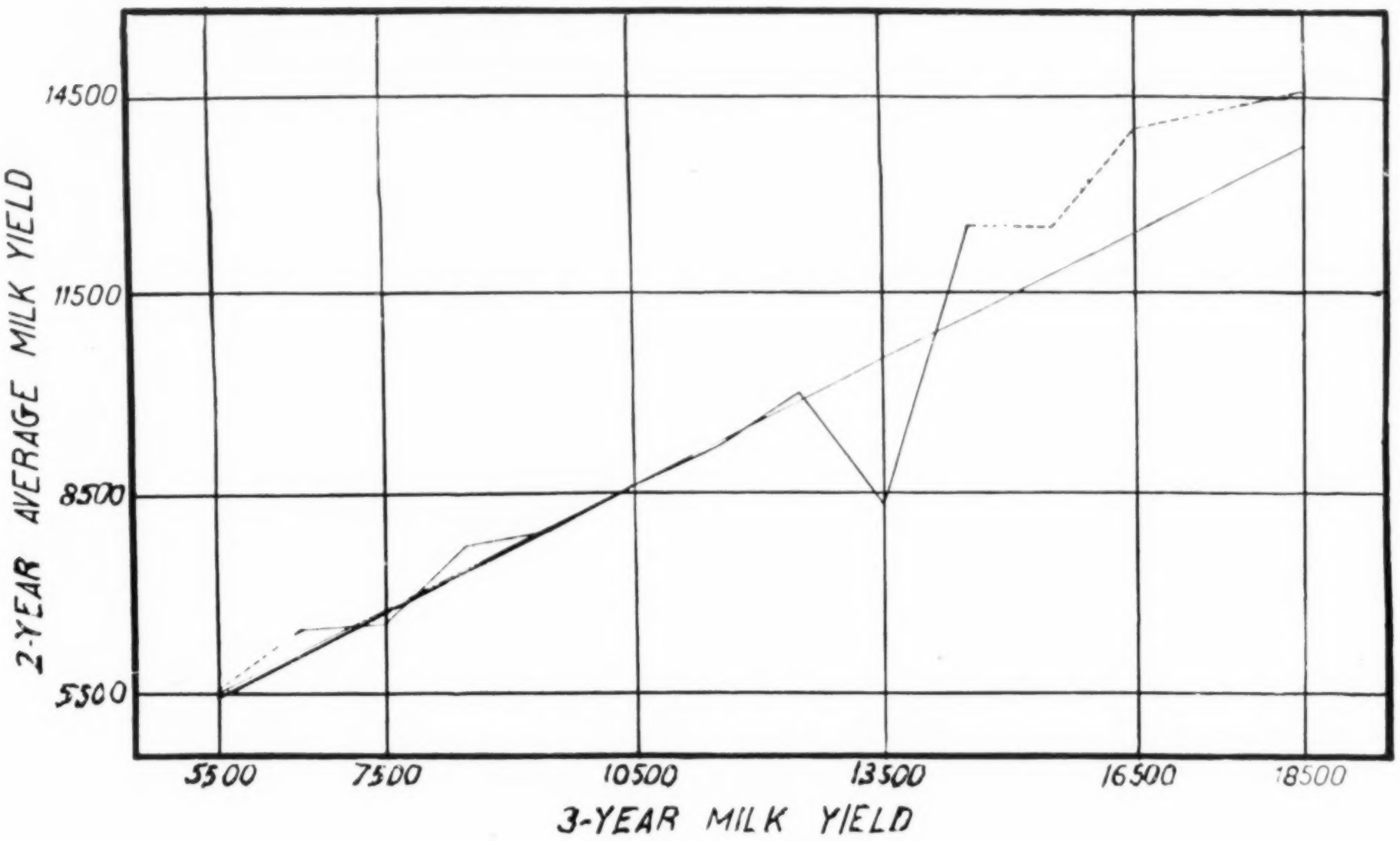
PREDICTION OF SUBSEQUENT PRODUCTIVITY BY MEANS OF 7-DAY AND 365-DAY TESTS

Figure 4

The length of the bars represents the correlation coefficient between the items indicated.

flow in relation to size of wells, size of milk veins, and length of milk veins, showed in general a small relation existed between these items and the milk flow which the cow gave over the lactation period. Even though the correlations are small they are distinctly significant, and it seems a reasonable conclusion that the size of the milk wells, the diameter of the milk veins, and the length of the milk veins are to a limited degree indicators of the probable productivity of the cow.

The American Jersey Cattle Club, under the able leadership of Mr. Gow, collected data on the score of over 1670 Jersey Registry of Merit animals. These scores were taken according to the score card of 1903. In principle such scores represent, in a scale according to the judgment of the observer, the relative perfection of the cow so scored as compared with that of the ideal type on which the score card is supposed to be based. The ideal is further supposed to be an ideal for the given age of the cow, thus making the scores on an age-corrected basis. When these scores are compared with the milk yields of those cows on a similar basis it is found that certain points of these score cards are related to milk yield in a small



MILK YIELDS COMPARED

Figure 5

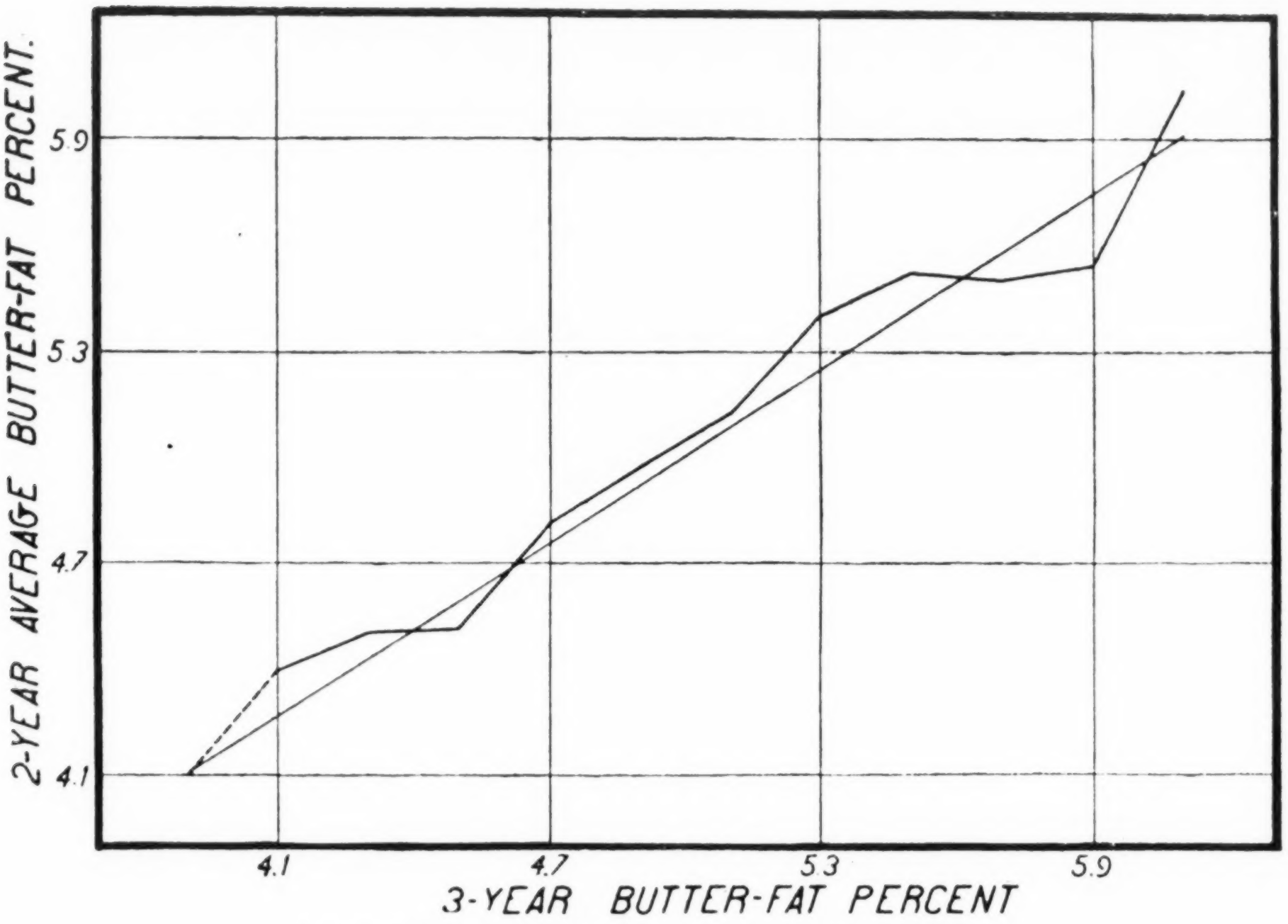
Relation of the milk yield of one lactation and another, Guernsey Advanced Registry cattle. The "Curve" represents actual observation of a large number of cows—the straight line represents the "regression," computed from all the points on the curve.

but significant degree. The correlation coefficients measuring this relationship have an order or magnitude entirely similar to those found by Aldrich and Dana in their study of the relation of milk yield to mammary vein development. In brief, the *total score* had the largest relation to the 365-day milk yield of the animal so scored. In the order of their merit the *milk veins,—udder large size, and not fleshy, —rear udder well rounded and well out behind,—body wedged shaped with large deep paunch,—general appearance,—thighs well cut out and flat, —rump long and level,* etc., were of importance in determining the milking capacity of the cow over the 365-day period. Thus the score card of 1903 has certain elements of conformation in it which are related to the productivity of the cow for milk production. These elements point to those indicating the size of the udder and its blood supply, and those indicating the size of the body as most important in determining the milk flow which the cow is able to give.

Butter-fat Percentage and Conformation

It is of interest to consider the question, do these parts of conformation indicate in any degree the concentration of the solids found in milk? Unfortunately we are limited in our study of this question to one solid, butter-fat production. When the butter-fat percentages are compared to conformation practically no correlation is found between the concentration of butter-fat in the milk and the conformation of the cow as determined from the score card.

The relation of conformation to productivity may be studied in another direction through the use of these same score cards, namely, the relation between the sire's conformation and the daughter's productivity. When the total scores for the sires were compared with their daughters' produc-



BUTTER-FAT PERCENTAGES COMPARED

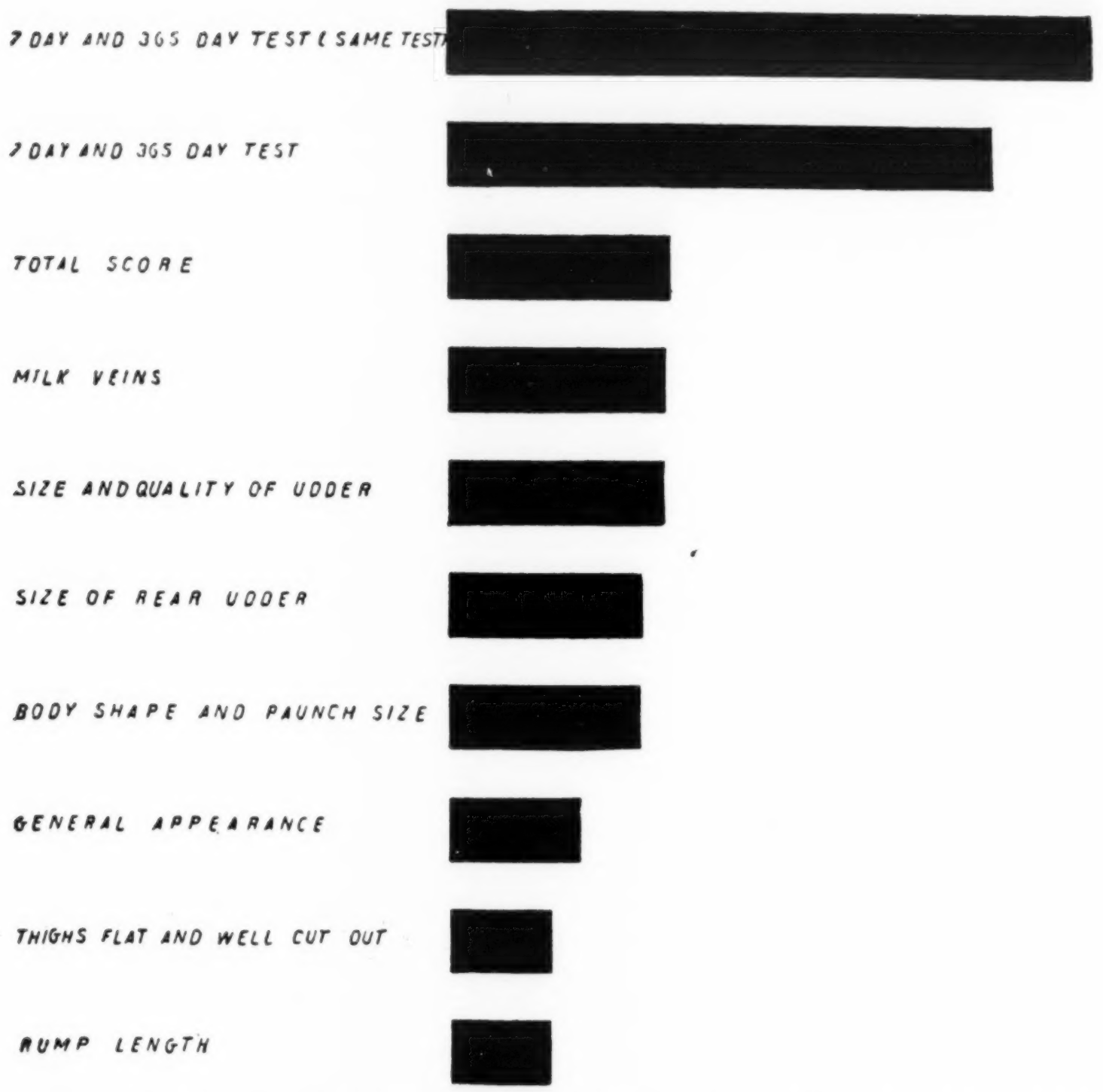
Figure 6

Relation of the butter-fat percentages of one lactation and another for Guernsey Advanced Registry cattle

tivity it was found that the relation for both milk yield and butter-fat percentage was very low, so low that the score of the sire could not be considered as an important factor in indicating the productivity of the daughter in so far as these score cards are concerned. It should of course be remembered throughout that the data are limited to cows making the Registry of Merit and therefore cows well up in the scale of production as found throughout the United States.

Correlation Between Conformation and Performance Records

The problem of the relation of conformation to productivity may be approached from a slightly different angle and we may thereby obtain a standard by which to measure comparisons. For cows giving milk it is possible to obtain a short time record on these cows which may be used to predict the productivity of such animals over subsequent lactation periods. It is of interest to compare this method of predicting production with the method of predicting production from the parts of conformation as such. A comparison of this type will indicate whether it is better to obtain short time records or to judge production entirely from conformation. If the Holstein-Friesian records be analyzed for the relation of their 7-day and 365-day tests it is found that such tests are related fairly closely as measured on the correlation scale. These correlations, in general, average between a correlation coefficient of .4 to .8. In other words, the correlations between the short time records and those of the lactation are considerably more than the correlations of the best


7 DAY AND 365 DAY TEST (SAME TEST
7 DAY AND 365 DAY TEST
TOTAL SCORE
MILK VEINS
SIZE AND QUALITY OF UDDER
SIZE OF REAR UDDER
BODY SHAPE AND PAUNCH SIZE
GENERAL APPEARANCE
THIGHS FLAT AND WELL CUT OUT
RUMP LENGTH

CONFORMATION OR PRODUCTION RECORDS AS A MEANS OF PREDICTING PRODUCTIVITY IN DAIRY CATTLE

Figure 7

The bars represent the correlation coefficient between milk yield and the variables indicated.

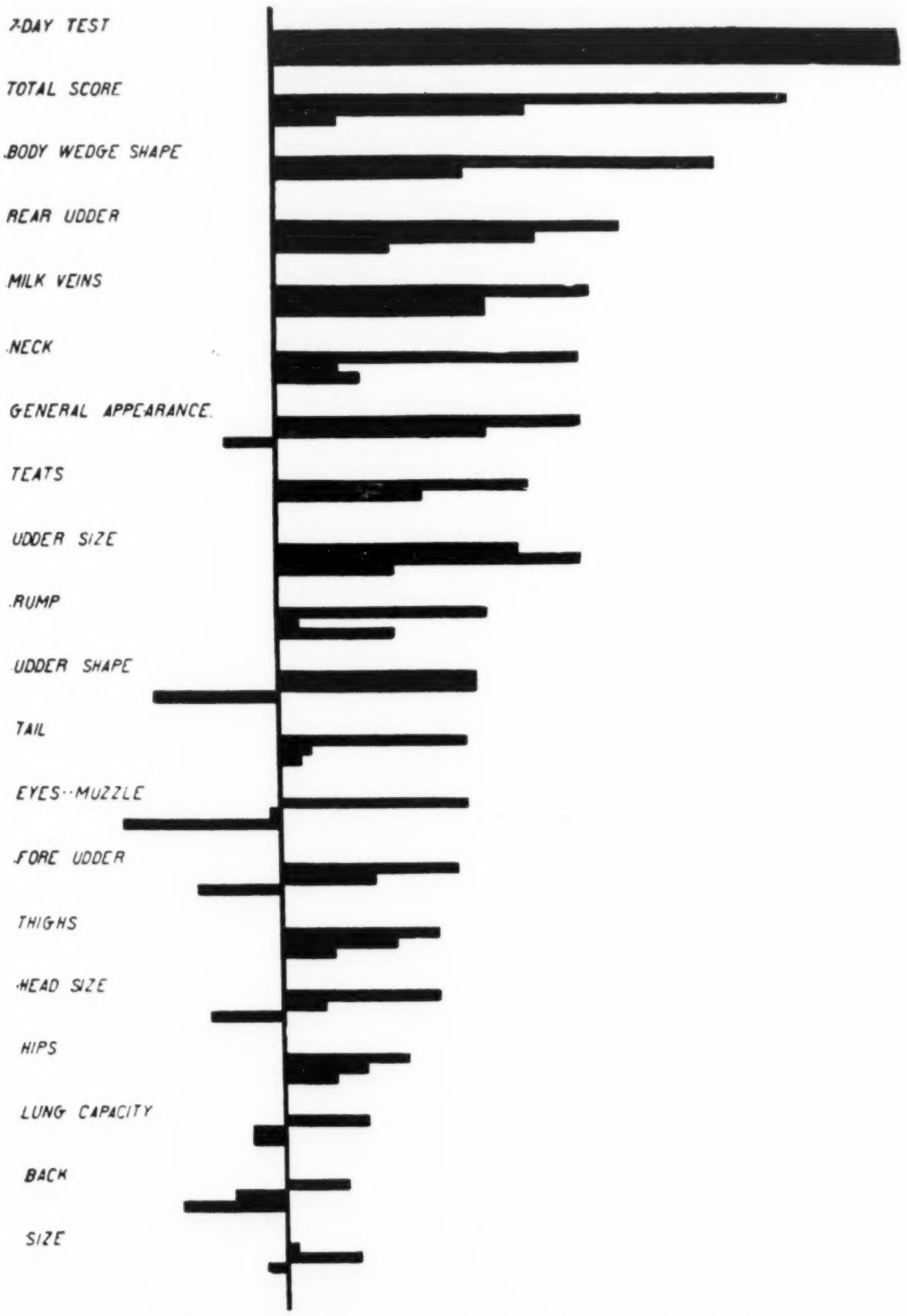
points of conformation as judged by score and the productivity of the cow for the lactation.

Figure 4 shows the relation of 7-day and 365-day records of Holstein-Friesian cows. The length of the bars represents the correlation coefficient between the items indicated. It is evident that for physiological variables like milk yield and butter-fat percentage, there is a high degree of relationship between the productivity of a short time test and that of a long time test. Similar facts hold for other breeds.

The relation of the milk yields of one lactation to another is shown in Figure 5 for the Guernsey breed. The data represent the lactations of the second and third years. It is evident from this chart that there is a high degree of relationship between the productivity of these periods.

A similar degree of relationship exists for the butter-fat percentage of the first and second lactations. These facts are shown in Figure 6.

A comparison may now be made between the relative merits of the short time tests, a record of a subsequent whole lactation or a record for conformation as indicative of the milk producing capacity of dairy cattle. Figure 7 shows these relationships. The lengths of the bars represent the correlation coefficients between milk yield and these variables. It is to be further noted that the butter-fat percentage of either the 7-day test or the 365-day test have relations comparable



THE PERSONAL EQUATION IN JUDGING

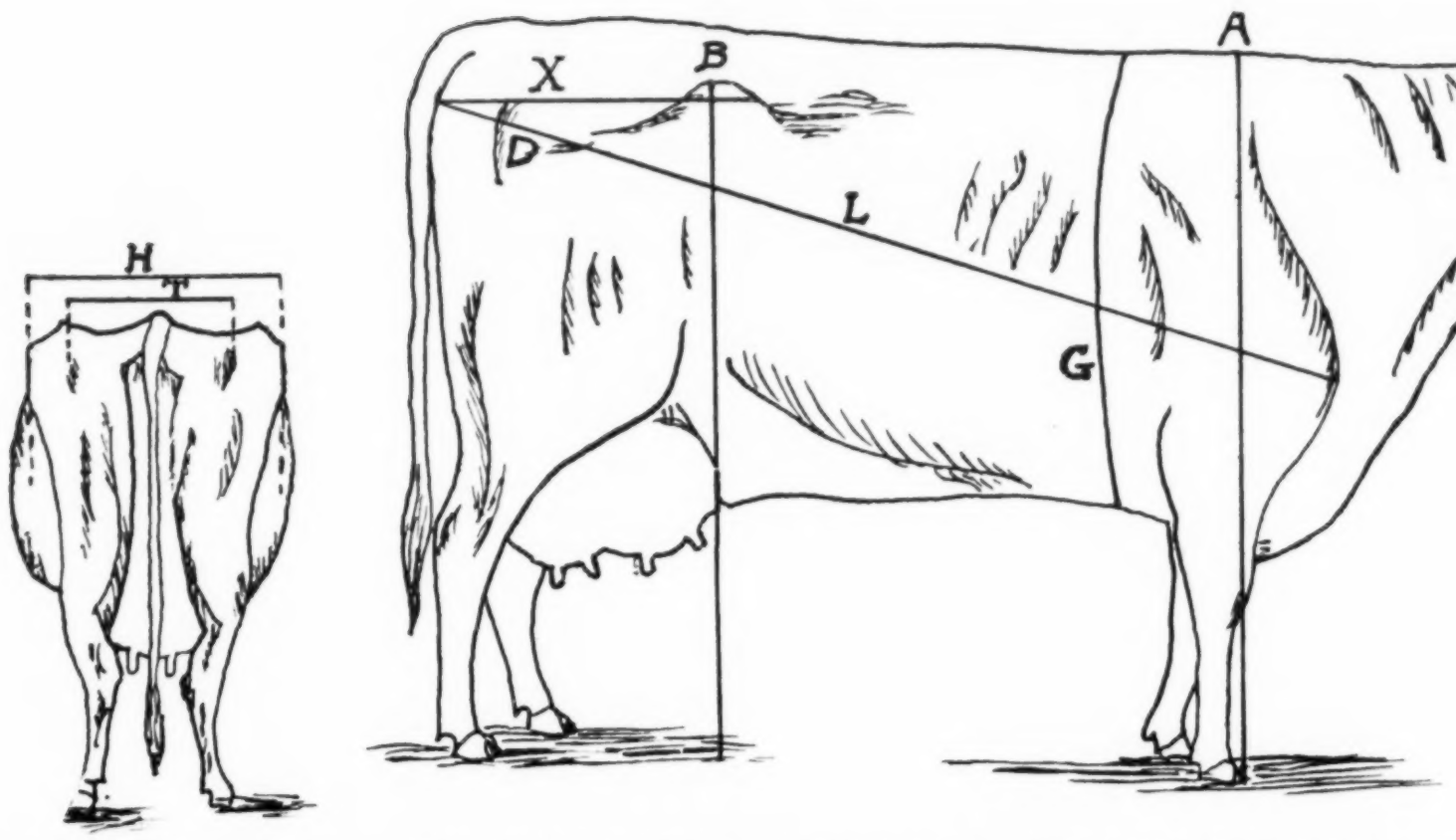
Figure 8

Merit of conformation in determining yearly milk yield when used by good, fair, or poor judges. The 7-day test is the standard of comparison. The length of the bars to the right of the vertical line represents the relative worth of the points. The good judges' ratings are given above, the fair judges in the middle and the poor judges at the lower edge of the bar.

to those of milk yield when compared from one lactation to another. Butterfat percentage on the other hand has no relation to any of the parts of conformation. It will be further noted that even for milk yield the records for conformation as measured by the score card are not more than two-fifths as valuable as those where the records are for a short time test.

The Personal Equation in Judging Cattle

It is to be remembered that the records of conformation based on a score card judgment introduces the personal equation of the cattle judge



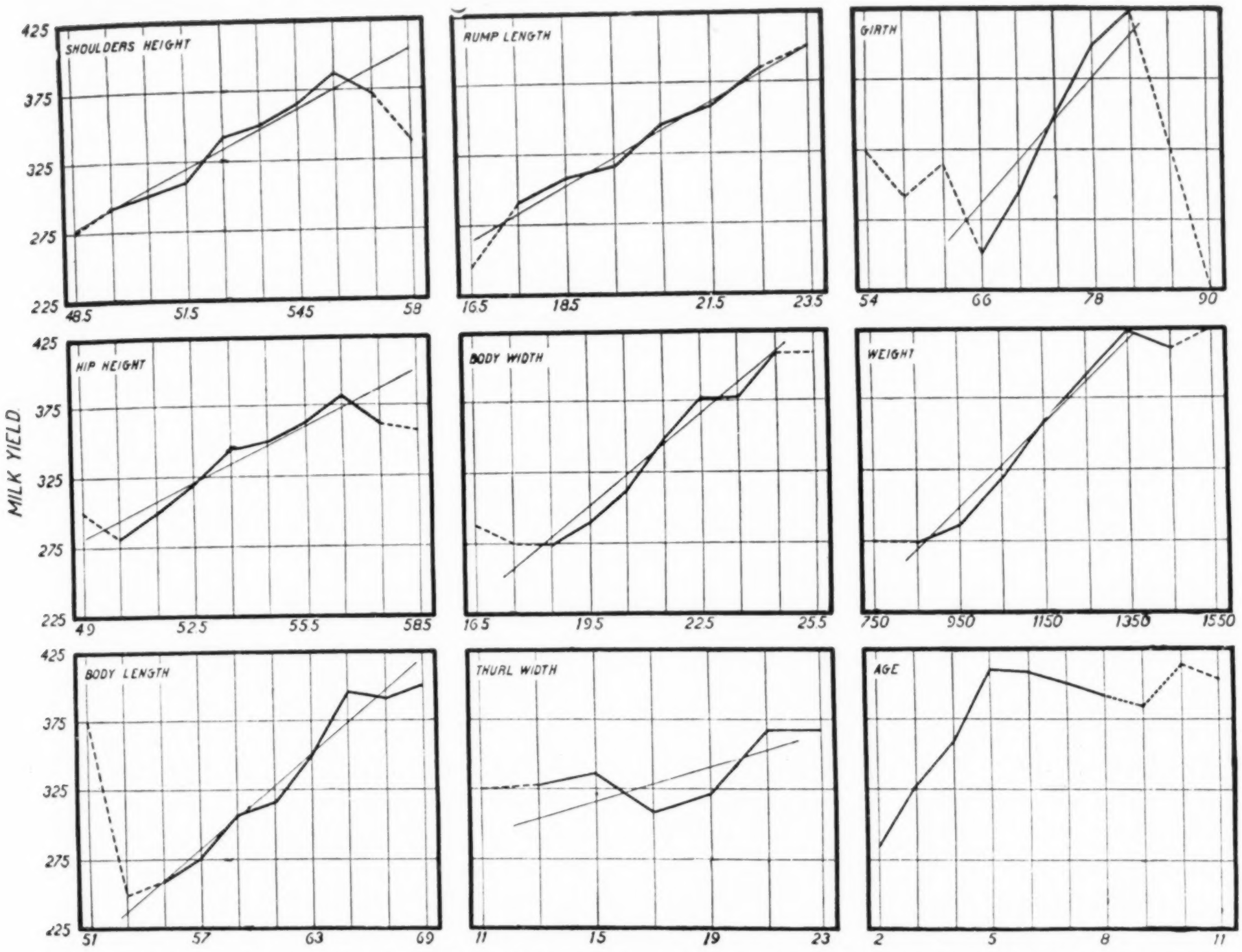
METHOD BY WHICH HOLSTEIN-FRIESIAN MEASUREMENTS WERE TAKEN

Figure 9

A=Height of Shoulders; B=Height of hips; L=Length of body; X=Length of hips; G=Girth; D=Thurl bone; H=Width of hips; T=Width at thurl.

into the problem. In other words, the judgment of one man may be on a different mental yard stick than that of another. Judges may differ tremendously in their conception of the ideal. The study of the personal equation as indicated by such factors as this, shows that there is a high personal equation in these records of the score of Jersey cattle in relation to their milk yields. Of the 19 men that judged more than 25 cows, nine could clearly judge dairy cattle by the score card and select the better milkers, eight were mediocre judges and two were worse than mediocre judges, giving the low producing cows better scores than the high producing cows. An attempt has been made to analyze the points of conformation on which the best judges place most reliance in selecting milk yield, (Figure 8). When such a study was made it was found that the points *total score, rear udder, body wedged shaped with large deep paunch, milk veins, udder large-sized, neck, teats, general appearance, thighs well cut out, udder—broad and level, and fore udder* were the most important in the hands of the best judges. Thus the good judges are superior to the poor judges in obtaining from a study of the conformation of the cow, information on these parts which will indicate the cows' probable productivity. Some of the points of conformation which apparently have equal value among all judges are milk veins, rear udder, total score, and udder large size and not fleshy. It is found, furthermore, even choosing the group of good judges, that these judges have a correlation coefficient between conformation and milk yield of but .38. In other words, even taking the most valuable part of conformation as determined from the score card and the best judges, a 7-day lactation record is almost twice as great in its correlation with subsequent producton as the parts of conformation. A 7-day record is consequently at least twice as valuable as the parts of conformation in indicating yearly production.

We may now turn to some data where actual measurements on the cattle are available in relation to their milk producing capacity. These records are on Holstein-Friesian cattle for the 7-day period. They represent animals making the Advanced Registry. The measurements taken are illustrated in Figure 9. All the meas-



RELATION OF BODY MEASUREMENTS AND AGE TO MILK YIELD IN THE HOLSTEIN-FRIESIAN COW

Figure 10

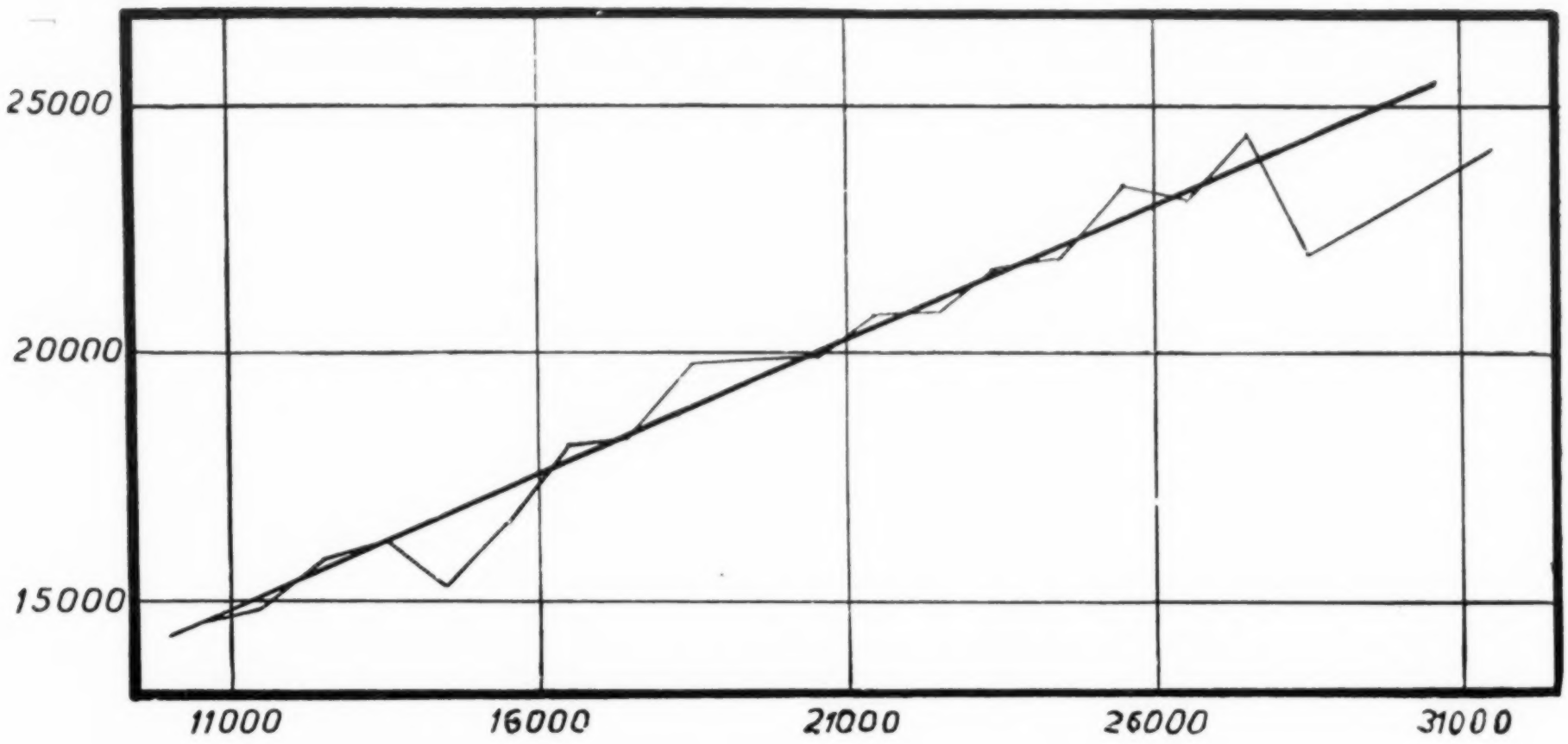
urements appear to have been taken with due care. The measurements are given in inches. The age of the cattle is given in years. The weight is given in either actual or estimated pounds. Weight is given on 339 cows, the measurements on 385. The relation of these different measurements to the milk producing capacity of the cows is shown in Figure 10.

Only the data for milk production are given, as the correlation coefficient for the parts of conformation and butter-fat percentage are insignificant in comparison with their probable errors. Table I shows these correlation coefficients.

Certain conclusions may be drawn from these charts. Those factors which tend toward increase in body size materially affect milk production. The most influential of these body measurements is that of *weight*. Closely following weight is *body length*, *hip width*, and *body girth*. It is interesting to note in view of the importance given to rump length as a supposed measure of the length of attachment of the udder that rump length has a relatively low relation to the productivity of these Holstein-Friesian cows. Hip width on the other hand has a rather high relation to the productivity of these cows. The relation of age to milk yield is not a true correlation coefficient as the regression lines are not linear. The whole effect of age is therefore not measured.

The Age Factor

It is evident that where age causes an increase in milk yield and body size, a correlation must result between



RELATION BETWEEN THE MILK YIELDS OF FULL SISTERS

Figure 11

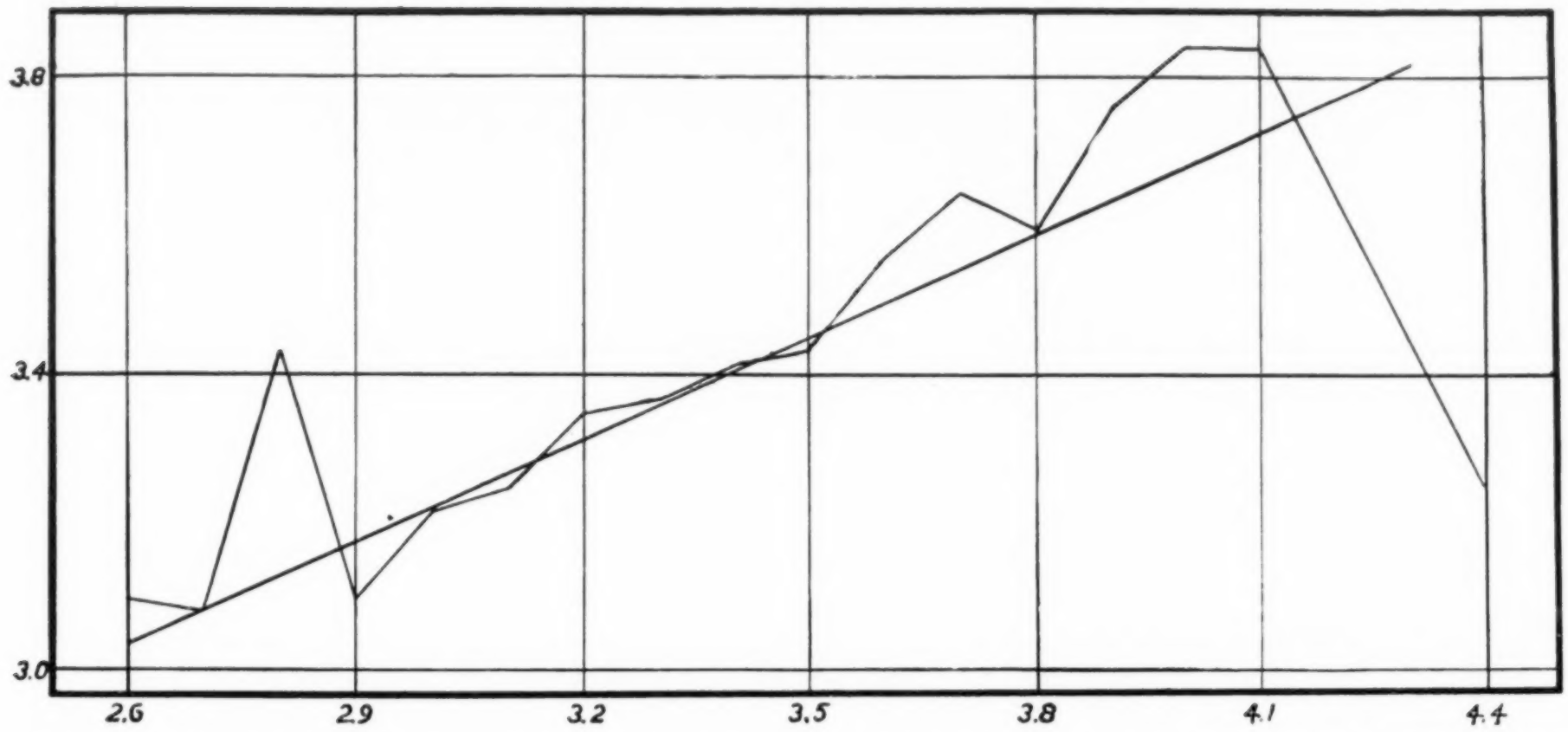
Holstein-Friesian Advanced Registry.

the measurements of the parts of conformation and milk yield when age is not considered, due solely and only to increases in the two variables due to age changes. It is therefore important to eliminate this variable, age, in trying to arrive at a true measure of the influence of conformation on milk producing capacity. This problem may be approached through the use of partial correlation coefficients. It was noted that the regression for these data is practically linear between age and milk yield up to the age of five years and six months. In view of this fact it seems desirable to use only those data for cows under this age. The data are further those which contain most of the observations, namely, 301 against 385 for the total data. A separate discussion of the 84 remaining observations will scarcely be of value as the correlation coefficient would be so markedly affected by the number of individuals contained in the data. Utilizing these 301 cases for cows under five years and six months, we find that the control of age materially reduces the correlation between the conformation and productivity. These results are indicated in Table II.

If the data of Table II are compared with those based on the score card correlation they are found to resemble each other in a marked degree, indicating that where age is made a constant factor the results based on the score card and on actual measurements are in agreement.

During the growing period of the individual animal, age is the factor of most importance, much more important than conformation in controlling milk yield. Body weight, body length, and hip width alone approach the importance of age in influencing milk production.

It is of interest to examine the total importance of the parts of conformation in determining milk yield. The variation of all the parts measured is highly correlated, one with the other. We may obtain the total effect of the variation in these parts on the milk yield of the cow by approaching the problem through the total correlation method. If we use age there will be ten variables in this total correlation. It should be realized that the total correlation coefficient will be influenced by the number of these variables and by the relatively small amount of data on which measure-



RELATION BETWEEN THE BUTTER-FAT PERCENTAGES OF FULL SISTERS

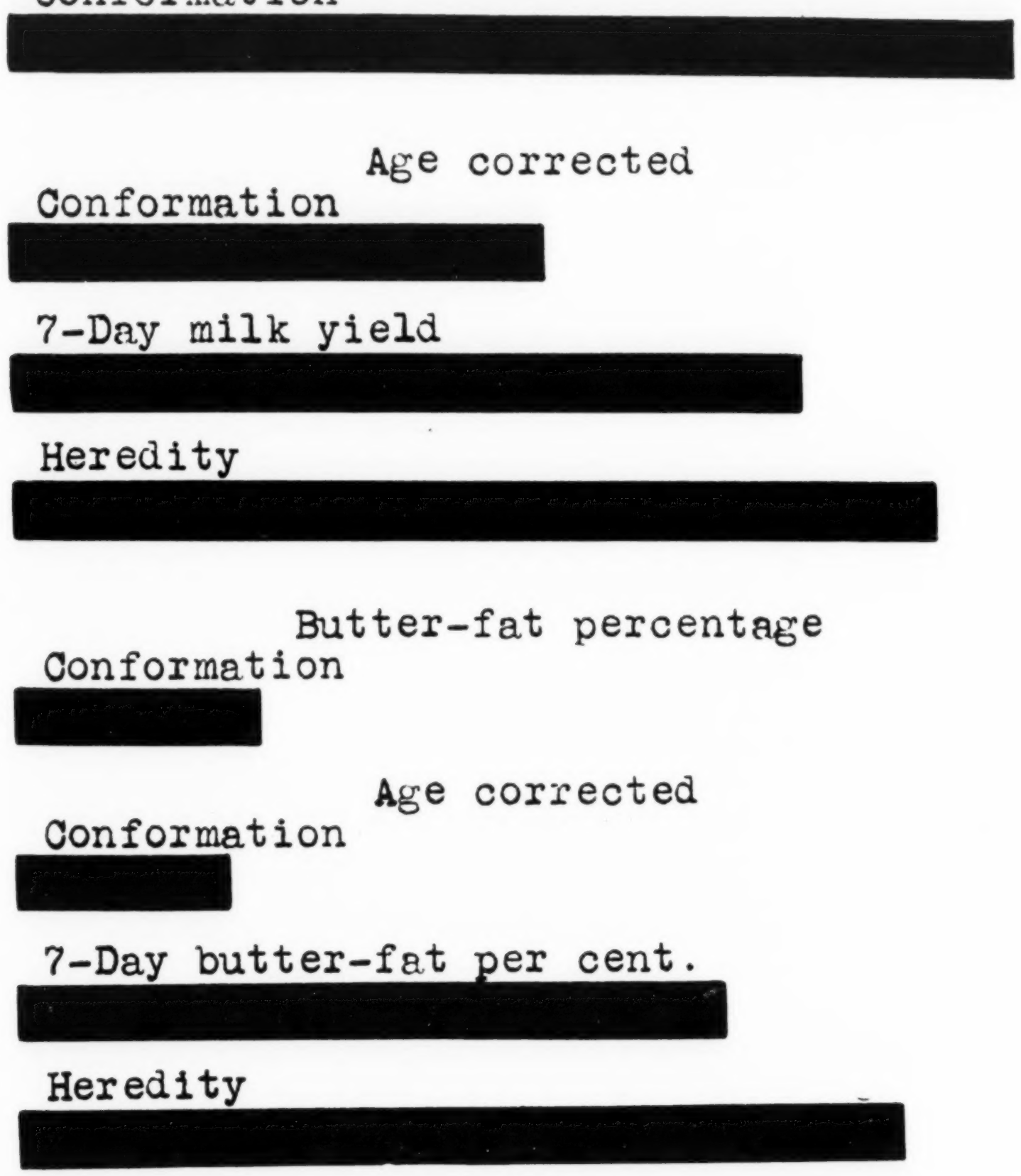
Figure 12

Holstein-Friesian Advanced Registry.

ments were obtained. It should also be noted that total correlations are to be interpreted with a great deal of caution, as the requirements for Gaussian surfaces and linear regressions are by no means always satisfied in such correlation tables. While of seemingly neglected importance these facts very materially influence the total correlation coefficient. By selecting the data in the manner indicated the regressions are in general linear.

Table III shows the correlation coefficients for all possible combinations of these data. It is clearly evident from the figures that all of the material is closely correlated. The value of the total correlation between milk yield and the variables, age and conformation, is about .73. It should be remembered that this total correlation is affected by the number of variables so that in all probability the true correlation is not more than .70. The problem which suggests itself is the problem of what combination of these variables would give a total correlation of practically this amount. It is clear on the face of the zero order correlation coefficient that either age, weight, or body length would give about 80 per cent of this total correlation. The utilization of age and weight, body length and age would utilize about 90 per cent of the total correlation. In view of the difficulty already pointed out concerning total correlation when a large number of variables is involved it seems entirely probable that by taking just the two variables, age and body length, or age and weight, the milk yield of the cow could be predicted practically as accurately as by the use of all of the ten measurements taken together. Thus, in so far as this group of measurements of conformation in concerned, practically as much information about the probable productivity of the cow may be obtained by considering just two of the parts of conformation as by taking them all.

The problem of differentiating between two cows of the same age on the basis of body measurements is equivalent to eliminating the factor age in the prediction. Under such conditions the total correlation no longer remains .6 or .7 but is very much reduced. If we utilize the body measurements which apparently are least affected by age, namely, weight and body length, in predicting milk yield of constant age, a total correlation of but .39 is found between con-



RELATIVE INFLUENCE OF VARIABLES ON MILK YIELD AND BUTTER-FAT PERCENTAGE

Figure 13

The length of the bars indicates the correlation coefficients.

formation and the 7-day test. If this correlation be compared with that found for the correlation of the 7-day test to the 365-day test for the same age, it is found that these correlations stand in the relation of six to four in favor of the 7-day test.

Heredity and Productivity

This problem may now be turned in the direction of how well conformation predicts productivity as compared with the influence of inheritance on productivity. The relation of the production of full sisters is given in Figure 11. The relation of the butter-fat percentages of full sisters is shown in Figure 12. It is clear that there is a high degree of relationship between the milk yields and butter-fat percentages of full sisters. It is, of course, to be remembered that conformation is no indication of the probable butter-fat concentration in the milk of these particular cows, whereas inheritance, as indicated by the relation of the records of these full sisters, does indicate probable butter-fat percentage.

Table IV shows the correlation coefficients for different combinations of ancestors. These correlation coefficients show the influence of the production records of the ancestors on those of the offspring. If suitable combination of these ancestors is used to predict the production of the cow it is found that the total correlation is relatively high. The productivity of the parents and grandparents will predict the probable production of the offspring as closely as the measurements of conformation of the animal in question. Since the correlation coefficients for the inheritance are on an age-corrected basis whereas those used for conformation are not, the superiority of inheritance is even more pronounced. Furthermore, in these data, the conformation predicts the 7-day record whereas inheritance predicts the 365-day record. Again the influence of inheritance can be obtained from the rather simple relation of the dam's and full sister's or the dam's and half sister's records.

From this rather brief review certain general conclusions may be drawn with regard to conformation as related to productivity. First, there is a relation between the conformation of the cow and her productivity such that a knowledge of conformation assists in the prediction of milk yield. If the measurements are taken with some general scale like a yard stick the prediction is on the whole superior to that on the basis of the ideal type contained in the mind of the average judge. The factors of conformation influencing productivity are those which indicate the size and capacity of a cow or the size and capacity of her udder. Conformation has little or no relation to the butter-fat concentration which a cow is able to secrete in her milk. In a study of the relation of the scores given to Jersey bulls to the production of their daughters, no correlation was found between these scores and either the milk yield or butter-fat percentage of the daughters. The production of Holstein-Friesian cows may be predicted with fair accuracy from the age, body length, body width, or weight or any combination of these measurements. When so predicted such a prediction is worth slightly more than half as much as a prediction of the 365-day record based on a short time test. These results are shown in Figure 13.

The problems of conformation are by no means settled by these considerations. The complacency with which the problem has been previously treated cannot but be shocked. It is an open question if the type of bull which we are now considering ideal is the type of bull that produces the ideal daughters as far as milk production is concerned. It shows a justification in the trend for selecting larger cows. It furthermore indicates many of the weaknesses of the present judging system.

TABLE I.—Correlation Coefficients—Conformation and Productivity in Holstein-Friesian Cattle.

Characters	Milk Yield	Butter-fat per cent
Age	.59±.02	.09±.03
Shoulder height	.38±.03	.04±.03
Hip Height	.34±.03	—.02±.03
Body length	.59±.03	.03±.03
Rump length	.39±.03	.06±.03
Body width	.52±.03	.07±.03
Thurl width	.21±.03	.16±.03
Body girth	.48±.03	.13±.03
Weight	.65±.02	.05±.03

TABLE II.—Correlation Coefficients—Conformation and Productivity in Holstein-Friesian Cattle Under 5½ Years.

Characters	Milk Yield	Age Constant
Age	.65	..
Shoulder height	.36	.11
Hip height	.36	.14
Body length	.58	.26
Rump length	.39	.13
Body width	.52	.19
Thurl width	.15	—.06
Body girth	.41	.12
Weight	.65	.35

TABLE III.—Conformation and Productivity in Holstein-Friesian Cattle. 5½ Years.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(x)
(1)	1.00	.65	.36	.36	.58	.39	.52	.15	.41	.65
(2)	.65	1.00	.44	.40	.66	.48	.63	.30	.50	.70
(3)	.36	.44	1.00	.84	.60	.44	.58	.27	.51	.55
(4)	.36	.40	.84	1.00	.52	.37	.49	.16	.44	.50
(5)	.58	.66	.60	.52	1.00	.55	.62	.28	.54	.64
(6)	.39	.48	.44	.37	.55	1.00	.67	.38	.45	.51
(7)	.52	.63	.58	.49	.62	.67	1.00	.48	.53	.69
(8)	.15	.30	.27	.16	.28	.38	.48	1.00	.32	.34
(9)	.41	.50	.51	.44	.54	.45	.53	.32	1.00	.57
(x)	.65	.70	.55	.50	.64	.51	.69	.34	.57	1.00

1. Milk yield
2. Age
3. Shoulder height
4. Hip height
5. Body length
6. Rump length
7. Body width
8. Thurl width
9. Girth
x. Weight

TABLE IV.—Correlation Coefficients for Different Combinations of Ancestors.*

	Milk Yield		Butter-fat percentage	
Daughter and Sire	.52		.53	
Daughter and Dam	.50±.02	.51	.41±.02	.47
Daughter and Paternal Grand Sire	.25		.34	
Daughter and Paternal Grand Dam	.26±.04		.09±.04	
Daughter and Maternal Grand Sire	.35		.39	
Daughter and Maternal Grand Dam	.31±.05	.29	.19±.05	.25
Full Sisters	.55±.03		.46±.03	
Half Sisters (Sire)	.36±.02		.37±.02	
Half Sisters (Dam)	.38±.03	.37	.22±.04	.30
Grand Daughters:				
Paternal Grand Sire	.07±.01		.18±.01	
Paternal Grand Dam	.30±.01		.34± 01	
Maternal Grand Sire	.24±.02		.22±.02	
Maternal Grand Dam	.34±.02	.24	.26±.02	.25
Cousins:				
Paternal Grand Sire	.01±.03		.12±.03	
Paternal Grand Dam	.17±.05		.21±.04	
Maternal Grand Sire	.21±.02		.22±.02	
Maternal Grand Dam	.23±.04	.15	.24±.04	.20

*See "Milk Secretion," Williams & Wilkins Co., Baltimore, 1925.

Nut Science

A New Theory of Growth

(*A correspondent sends the following gem, but without mentioning the source, so we are unable to give credit for the discovery.*)

One hot summer day, while traveling in Ceylon, I mentioned being very thirsty. We were near some cocoa-palm trees, and our guide called to a young Singhalese boy, who quickly climbed up the slender trunk of one of the trees and threw down several of the young nuts. The guide sliced the tops from the nuts, and, behold, there was a sparkling cool and most deliciously refreshing drink in a natural cup. I was surprised to find the water so cold, until I realized that the constant evaporation caused by the sun and breeze on the porous shell had caused it. (The water, evaporating, leaves its solid content within the shell, forming the meat of the mature nut.)

INHERITANCE OF WOOL CHARACTERS IN SHEEP

A Review

FROM needs and problems of practical sheep breeding in Germany has developed in the course of recent years an increasing interest in questions of the inheritance of wool characters. A series of significant results of these investigations already has been published, among which Kronacher's studies are especially remarkable. The voluminous book by Spöttel* is devoted to one trait only, the fineness of the wool. Spöttel's book essentially consists of four parts. The first part deals with the methods of measuring the fineness of the hair. At first the author points to different physiological factors (as age, pregnancy and lactation, diseases, etc.) influencing the thickness of the hair, which have to be taken into account as sources of error. These factors cause a certain variation in the diameter of different parts of one and the same hair.

Methods of Measurement

After critically reviewing the methods previously employed in determining the diameter of the hair the author adopts the following method in his own investigations. The measurements have to be taken on the same part of each hair (viz., the base) in all the hairs to be measured from the different body regions. This guarantees the necessary uniform condition of the growth of all the hair. For measurement, the hairs were immersed in glycerine; the measurements must be taken shortly after immersing the hairs because otherwise the glycerine is absorbed and causes errors. Selective measurements have to be avoided very carefully. For obtaining a reliable mean of the diameters of the hair, the coarser and less uniform the hairs, the more measurements are needed. But the mean as such generally does not give a trustworthy expression of the different hair types composing the wool assortment. It is preferable to state the percentage of the different hair types and to give the graphical expression of the fineness of the hair. The unreliability of the means is chiefly caused by the fact that for the most part the frequency curves of the diameter of the hair are asymmetrical or steep-sided and sometimes even multimodal.

The second part is an account of the values the author has obtained with his method for the wool of different breeds of sheep. This chapter is probably the most valuable part of the book because it brings together a great number of facts which will be very important for further investigations. Spöttel reports measurements of the following breeds: Merino, Würtemberger veredeltes Landschaf, Oxfordshiredown, Hampshiredown, Suffolk, Leine, Rhön and Moorland sheep. Including the wool from different body regions and the coarsest as well as the finest wool of every breed, Spöttel found that racial differences with regard to the hair types of the wool assortment can be verified only in rare instances. Even for groups of breeds the frequency curves commonly overlap. Monomodality of the frequency curves with a high mean could be established for Merinos, Würtemberger improved sheep, Hampshire, Oxfordshire, Suffolk, Dishley-Merino and Mele (Merino-Leicester). But in all

*Spottel, Walter, Uber Variabilität, korrelative Beziehungen und Vererbung der Haarfeinheit bei Schafen. Bibliotheca Genetica vol. VII. Gebrüder Borntraeger, Leipzig, 1925.

these breeds asymmetrical frequency distributions are prevalent. The same compositions of the wool assortments have been obtained for medium fine to coarser Merino wool, for the fine wool of English mutton breeds (Hampshire and Oxfordshire) and of German improved sheep (fine Würtemberger). The bi- and multimodality of frequency curves for the thickness of the hair has its chief cause in the presence of different hair types and rhythms of growth.

Effects of Internal Secretion

The third part of the book deals with the correlations between the fineness of the wool and other morphological and physiological characters. The author reviews the reports from the literature concerning these questions and discusses (with conclusions probably too far reaching for the rather scanty facts) the meaning of internal secretions in controlling the fineness of the hair. Spöttel undertook no new experiments in this field. He compares the traits of pure-bred mutton sheep and wool breeds with the effects of the extirpation of glands of internal secretion and from this comparison draws the conclusion that many of the typical traits of these one-sided breeds can be explained as consequences of a functional atrophy of glands of internal secretion. It seems probable to Spöttel that the typical characters of the Elektoral (as the fineness of the wool) are caused by a decreased or changed function of the epithelial bodies, that the distinctive characters of the Negrettis (the wrinkles of the skin, the fineness of the wool, etc.) are a consequence of a decreased or changed function of the thyroid (perhaps with a coexisting similar change of the epithelial bodies) and finally that the peculiarities of the mutton sheep find their reason in a functional atrophy of the *pars intermedia* of the hypophysis. Future investigations are needed to show how far the relationships between these two sets of facts are casual and how far they are only coincidencies.

Inheritance of Wool Fineness

The last part, comprising the second half of the book, is devoted to the inheritance of the fineness of the wool. A critical review of the previous literature leads Spöttel to the conclusion that the Mendelian inheritance of the fineness of the wool has not yet been established conclusively, or that "mindestens die Erklärung durch die Annahme einer unreinen Anlagenspaltung offen bleibt." Spöttel criticises in great detail Terho's results on Mele sheep, the most important earlier paper concerning these questions. Probably one will agree with Spöttel's statement that it was a doubtful attempt to assume 7 to 9 separate factor pairs* for the explanation of the *variability* of the thickness of the hair (besides 5 to 6 factor pairs for the thickness of the hair itself), but on the other hand, Terho has shown quite convincibly the segregation of Mele wool in Merino and Leicester wool types. Spöttel's own genetic investigations (on material of the institute for animal husbandry at Halle) have been performed on wool of Moufflon-Merino and Somali-Merino crosses. Among the F_1 Moufflon-Merino crossbreds Spöttel found that most of the animals showed an almost complete Merino appearance with regard to the fineness of the wool, but some were of intermediate and one of Moufflon type. He reports furthermore that some of the animals in the course of several years changed the composition of the hair from the Moufflon to the Merino type. The F_2 animals showed a similar heterogeneity of type with still more extreme limits on both sides. The graphical presentation of the thickness of the hair of some animals shows two distinctly different regions of the curves, in others one side of the curves

*Calculated by Castle's method.

(coarse hair) is missing altogether and still others have three maxima in the frequency distribution. Manifold intermediate stages have been found between these three extremes. Yet Spöttel found also cases in which both parents (F_1) have been decidedly intermediate and their offspring was partially of the Merino and partially of the Moufflon type. Generally Spöttel found, as other investigators had previously, an increase in the fineness of the wool with advancing age. Out of seven F_3 animals six showed with regard to the thickness of the hair a more or less typical Merino wool, whereas the last had the typical Moufflon appearance. For the factorial interpretation of his results Spöttel thinks it necessary to assume at least seven multiple factors for the coarse Moufflon hair and in addition five factors for the appearance of the greatest number of "Zwischenhaaren" (intermediate hair types). Furthermore the Moufflon condition of hair, according to Spöttel, has to be assumed as being heterozygous. Analyzing his Somali-Merino crosses Spöttel reaches results similar to those obtained in his Moufflon-Merino crosses. We shall here only refer to his statement that the F_3 generation in spite of a great dissimilarity of the animals among each other stands at first relatively near to the Somali type and changes later on the composition of the fleece in the direction of the Merino type.* We miss here exact details on the influence of age on the pure Somalis, which only could show whether it is really correct to speak of a change to the Merino type, or whether we are dealing only with the fineness of the wool typical of advanced age. All backcrosses of F_1 and F_2 animals with Somalis (seven individuals and three individuals respectively) are reported by Spöttel as being of the Somali type or very near to it; but after all it follows from his description that intermediate animals and at least one similar to Merino have also been found. Spöttel calculates from his results with Somali-Merino crosses that for the pure factorial explanation it would be necessary to assume seven multiple factors for the expression of the coarsest hair and seven factors for the "Zwischenhaare." Besides that the occurence of a change of the phenotype of the hair character with advancing age must be assumed in these crosses.

In his concluding discussion Spöttel rejects more or less decidedly the possibility of explaining factorially the inheritance of the fineness of the wool. He thinks it necessary to assume that the fineness of the hair of a certain breed is the product of the physiological influences of the general constitution of the body on the primordia of the different hair types. "Beruecksichtigt man diese Gesichtspunkte bei der Interpretation der Vererbungserscheinungen der Mufflon—und Somalikreuzungen, so kommt man zu der Anschauung, dass eine unreine Spaltung derjenigen Anlagen stattgefunden hat, auf die die einzelnen Teile des Organismus zurückzuführen sind, deren Stoffwechsel—oder Sekretionsprodukte die Feinheit der Haare bedingen."

It certainly is very well to be sceptical with regard to a factorial interpretation of complicated multiple factor conditions, especially if relatively few results have been obtained. But no reason whatever can be seen to work with conceptions as obscure as impure segregation ("unreine Spaltung").† With regard to all previous results and to Spöttel's own there is, it seems

*In discussing the problems of the changes of the phenotype ("Valenzwechsel") Spöttel says (p. 175) cases are known in which RR-plants changed to DR and DD-plants to RR. He means that in certain instances heterozygous plants in the course of development change their phenotype from that of the one to that of the other parent.

†E. Bauer in his "Verebungslehre" says rightly: "Eine 'unreine' Spaltung kennen wir also nicht."

to me, no doubt that the fineness of the hair is inherited by multiple factors. And Spöttel certainly is right in saying that several physiological factors influence the embryonic and later development of the hair. It remains a problem of future investigations to find out the genetics of these modifying physiological factors as well as their action during development.

WALTER LANDAUER,
Storrs, Conn.

The Family

THE FAMILY AND ITS MEMBERS, by ANNA GARLIN SPENCER. J. P. Lippincott Co., Philadelphia and London, 322 pp. 1923.

A text for college students and study groups in women's clubs but deserving in an exceptional degree of thoughtful reading by a wider circle. Though the viewpoint is social the author appreciates fully the importance of heredity.

"The Family," "Mother," "Father," "Grandparents," "Husbands and Wives," "Children," "The Broken Family" and "The Family and the School" are titles of some of the chapters, although they give little idea of the strength of the discussion. The author recognizes the danger to society from the late marriage and the few children of the abler part of the race and from the large number of superior men and women who for various reasons remain single. She is not content with merely pointing out the danger but discusses causes and necessary adjustments. She considers that it is possible for most able men and women to marry and rear families "provided they are willing to pay the price of simplicity in the home and in individual mastery of the technic of new ways of living."

The family unit is considered as a priceless inheritance from the past, many of the customs of which must be modified to suit new social demands. Changes to give the highest social value to each individual of the family are considered. That in actual family service in its broader sense there is place and opportunity for high personal achievement by women, that married women and mothers may serve the family and have outside vocations, and that outside vocations of men and women alike must be modified in order that fathers and mothers may share in family responsibilities and each have vocational interests which heretofore afforded men such satisfaction, are conclusions of the author.

Her discussion of child-labor in agriculture (p. 178) is perhaps the weakest part of the book. That there is social wrong and genetic loss from exceptional instances of child-labor in agricultural production cannot be denied, but our judgment is that in general the work of children in the fields is not detrimental. On the contrary, it has been and still is one of the most important and valuable contributions to the training and development of a very large part of American children. Specialized and scientific farming tend, not to make such labor more injurious, but still more valuable.

A. M. Darrow.